

## Claims

1. A needle for use with means to inject or remove material comprising (i) a tip which tapers to a point, (ii) an elongate section adjacent the tip, said elongate section comprises one or more ramps and optionally a parallel section, (iii) a barrel section in fluid connection with the means to inject/withdraw material, there being an inner bore comprising a fluidic pathway, which inner bore is within the barrel and optionally extends partially or fully down the elongate section and/or to the tip, there being one or more apertures fluidically connecting the said inner bore to the outside of the needle, and at least part of at least one aperture is lateral or on or adjacent to the barrel and/or the elongate.  
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- 10 2. A needle as claimed in claim 1 in which the tip has a cutting end with one or more bevels sharpened into blades.
- 15 3. A needle as claimed in any one of claims 1 or 2 in which the needle has a non cutting atraumatic tip, smooth and with a conical or curved tip with substantially curved radii at the foremost point so that, in use it substantially parts tissue without cutting.
- 20 4. A needle as claimed in any one of claims 1 to 3 in which the tip is a sharp, partially sharp or non sharp blade of cross sectional area smaller than that of the elongate section.
- 25 5. A needle as claimed in any one of claims 1 to 4 in which the needle tip has an outside diameter of about 0.2 to 5.0 mm.
6. A needle as claimed in any one of the preceding claims in which the needle length is 2 to 200mm.

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7. A needle as claimed in any one of the preceding claims in which the needle tip diameter is 1% to 99% of barrel diameter
8. A needle as claimed in any one of the preceding claims in which the ratio of the tip diameter to the barrel diameter is between 1:1.01 and 1:100
9. A needle as claimed in any one of the preceding claims in which the ratio of the fluidic capacity of the barrel to the tube equivalent of the tip is between 1.05:1 to 1000:1.
10. A needle as claimed in any one of claims 1 to 9 in which at least part of the elongate section has a ramp where the effective outside dimension is made to increase gradually and/or in one or more steps from the tip until it joins the barrel section
11. A needle as claimed in claim 6 in which the overall angle of one or more step/gradient and the angle and/or radius of the leading and trailing edges of step/gradient is chosen to ease entry with minimum force and/or pain/trauma of the skin/tissue being penetrated.
12. A needle as claimed in any one of claims 1 to 11 in which the elongate section has a fluid carrying bore or channel connecting fluidically to an aperture at tip and the bore or channel is of o, c, u, x, shape etc.
13. A needle as claimed in any one of claims 1 to 12 in which at least part of at least one aperture is spaced away from the tip and/or closer to the barrel than the tip.
14. A needle as claimed in any one of the preceding claims in which the barrel has an outside diameter of 0.2 to 25 mm.

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15. A needle as claimed in any one of the preceding claims in which the bore and/or outside diameter of the barrel and elongate section and /or tip varies.
16. A needle as claimed in claim 15 in which the bore and/or outside diameter  
5 changes at the connection between the barrel and the fluid holding or dispensing part.
17. A needle as claimed in any one of claims 1 to 16 in which all or part of the barrel section is inside the connection to a fluid container and made such that the majority of the greater than average bore of the needle does not penetrate the skin, but  
10 conducts the fluid to the point where the bore does penetrate the skin.
18. A needle as claimed in any one of claims 1 to 17 in which the elongate section is hollow or solid and has a wall thickness greater or lesser than the barrel
- 15 19. A needle as claimed in any one of claims 1 to 18 in which, in use, the elongate section maintains or increases the size of a path in tissue formed initially by the tip, and eases and directs the flow of fluid at least partly along or around the outside of the needle at least partly in a forward direction towards the tip..
- 20 20. A needle as claimed in any one of claims 1 to 19 in which, in use, when fluid pressure is applied, the elongate section forms all or part of a channel which nucleates or eases and directs the passage of at least part of the fluid flow with a smaller pressure drop than if the fluid were constrained inside the bore of the tube in that same location.
- 25 21. A needle as claimed in any one of claims 1 to 20 in which the aperture encompasses 10% or more of the circumference of the bore of the barrel.
- 30 22. A needle as claimed in any one of claims 1 to 21 in which the aperture is in the form of a groove or slot.

23. A needle as claimed in any one of claims 1 to 22 in which the one or more apertures extend in length more than 5 diameters of the adjacent tube and have an aspect ratio of more than 5:1 length to depth.

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24. A needle as claimed in any one of claims 1 to 23 in which the one or more apertures have an included angle of less than 12° and the aperture(s) are positioned and angled to induce fluid to flow along and adjacent to the elongate section and are positioned and angled and radiused to reduce catching, cutting or coring of particulate

10 fluid or skin or tissue in use.

25. A needle as claimed in any one of claims 1 to 24 in which at least part of at least one aperture is away from the tip and/or on a section of larger outer dimension than the tip.

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26. A needle as claimed in any one of claims 1 to 25 in which the overall dimension of at least one aperture is larger than the tip outer dimension by a factor within the range of 10% or more.

20 27. A needle as claimed in any one of claims 1 to 25 in which the one or more aperture(s) are longitudinal or radial, round or elongate or a slot or a groove, and can penetrate through one wall or through both walls of the tube.

25 28. A needle as claimed in any one of the preceding claims in which the aperture is in the form of a slot which is deformable and expands under pressure in use

29. A needle as claimed in any one of the preceding claims in which at least part of at least one aperture is spaced apart from the tip and is located substantially where the there is a gradient or step change in the outside diameter.

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30. A needle as claimed in claim 29 in which one or more apertures is on or adjacent to a gradient or step change in outer dimension other than the tip.

31. A needle as claimed in any one of the preceding claims in which at least part of 5 gradient is positioned away from the heel of aperture at syringe end of aperture i.e. on opposite side of aperture from the tip.

32. A needle as claimed in any one of claims 1 to 31 in which at least part of at least one aperture is located on the gradient where the elongate section joins the barrel.

10 33. A needle as claimed in any one of claims 1 to 31 in which at least part of at least one aperture is located on the elongate section and optionally can or cannot not adjoin the tip.

15 34. A needle as claimed in any one of the preceding claims in which the aperture is greater than 1-10mm long

35. A needle as claimed in any one of the preceding claims in which the aperture nearest the tip is spaced apart from the tip by more than about 0.5mm..

20 36. A needle as claimed in any one of claims 1 to 35 in which the aperture has an aspect ratio of width to length in the range 1:1 to 1: 500

25 37. A needle as claimed in any one of claims 1 to 36 in which the aperture has an aspect ratio of width to length greater than 1:10

38. A needle as claimed in any one of claims 1 to 37 in which the aspect ratio of the inner bore diameter to slot length is greater than or in range of 1:2 to 1:50

39. A needle as claimed in any one of claims 1 to 38 in which the aspect ratio of the inner bore diameter to slot length is greater than 1: 5.

40. A needle as claimed in any one of claims 1 to 39 in which the aspect ratio of the outer tube diameter to slot length is greater than or in range 1: 2 to 1:50

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41. A needle as claimed in any one of claims 1 to 40 in which the aspect ratio of the outer tube diameter to slot length is greater than 1 to 4.

10 42. A needle as claimed in any one of claims 1 to 41 in which the ratio of slot length to overall needle length is greater than or in range 1:1.5 to 1:10

43. A needle as claimed in any one of the preceding claims in which the end of the aperture nearest the tip is open.

15 44. A needle as claimed in claim 42 in which the barrel enters the skin and the elongate section is solid and the aperture at the end of the barrel adjoins to the groove or slot and the groove or slot goes to the tip end of the needle

20 45. A needle as claimed in any one of claims 1 to 43, in which the end of the channel or bore nearest the tip is closed.

46. A needle as claimed in claim 45 in which the needle is a solid needle and the aperture is a groove or slot and the groove or slot terminates at a position spaced apart from the tip.

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47. A needle as claimed in any one of the preceding claims which can incorporate a balloon catheter which comprises a deformable or elastic sheath which has an aperture or apertures in it, which sheath fits around or encases the needle and in use

the aperture or apertures in the sheath are below the skin and connect with the aperture in the needle.

48. A needle as claimed in any one of the preceding claims in which the needle has a  
5 length of 2 to 200mm.

49. A needle as claimed in any one of the preceding claims in which there is overall a minimum (from approximately 10% to 90%) of cutting and displacement by the needle itself in relation to the fluidic capacity of an equivalent conventional needle.

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50. A needle as claimed in any one of the preceding claims in which there is a minimum total dimension (length and or area from approximately 10% to 90%) of sharp cutting edges and/or points, and minimum level of sharpness in relation to the size and fluidic capacity of an equivalent conventional needle

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51. A needle as claimed in any one of the preceding claims in which in use the small aperture formed in skin and tissue by the tip is smoothly extended along the tip and elongate section with minimum of sharp edges or sharp changes in direction to catch or snag tissue

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52. A needle as claimed in any one of the preceding claims which comprises at least one separate component made of one or more different materials and which the separate parts are joined together

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53. A needle as claimed in any one of the preceding claims which is made by process steps comprising forming a step in the diameter of a needle tube, closing the tip of needle, forming a primary angle onto tip, processing by mechanical or chemical means to increase the radii of the edges of the tip and aperture, forming step to make final tip dimensions

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54. A process of making a needle which needle is as claimed in any one of the preceding claims which process includes the steps of providing surface texture to reduce friction and/or retain lubricant at surface before and during use.

5 55. A process of making a needle which needle is as claimed in any one of the preceding claims which process includes increasing the edge radii of the tip and/or heel and/or edges of one or more apertures to prevent catching or snagging of fluid contents and/or skin.

10 56. An injection device incorporating a needle as claimed in any one of the preceding claims

57. A needle and injection device as claimed in claim 56 in which the injection device comprises a syringe, pen, autoinjector, syringe driver, tissue/fluid extraction device.

15 58. A needle as claimed in any one of the preceding claims in which the length of the needle is chosen for the application of the needle.

59. A needle as claimed in claim 58 in which the applications are selected from the

20 use of the needle to add or remove substance including intradermal, sub-cutaneous, intra-muscular, intra-venous, into bone, into joint, into eye, into any organ or space, and for keyhole surgery.

60. A needle as claimed in any one of the preceding claims in which there is a concave curvature on the face of tip and/or on other parts of needle and/or with ridges, rails or splines to reduce force/friction of needle against skin/tissue and/or coring of tissue into aperture.

25 61. A needle as claimed in claim 60 in which the depth of the concave section is 1-80% of adjacent needle outer diameter.

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62. A needle as claimed in claim 60 in which the depth of the concave section is 1-80% of adjacent needle diameter and the concave section is radius to 1-200% of outside diameter

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63. A needle as claimed in any one of the preceding claims in which there is a needle guide surrounding the needle which restricts the axial or lateral movement of needle and/or liquid holding elements attached to needle.

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64. A needle as claimed in claim 63 in which the guide restricts needle transaxial or lateral movement in use to below 0.01-1°; 1-10°; 0.1-1mm; 1-3mm.

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65. A needle as claimed in claim 63 or 64 in which the guide has one or more sprung elements to maintain tight tolerance while allowing for variations in manufactured size and guide has minimum contact with moving needle-holding element to reduce friction.

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66. A needle as claimed in any one of the preceding claims combined with an autoinjector or pen.

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67. A needle as claimed in previous claim 6667 in which the autoinjector or pen has high pressure delivery of fluid in the range 0.1-200 bar or more.

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68. A needle as claimed in any one of the preceding claims in which the part of the needle barrel where the fluid first meets the constriction at the opening of the barrel has an entry-aperture of smaller inner dimension than the bore of the barrel for example included angle is below 90° or is of inverted funnel shape, whereby in use the first entry-aperture encountered by the fluid is of smaller inner dimension than the bore of the barrel.

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69. A needle as claimed in any one of the preceding claims in which the needle barrel projects into the injector or syringe so that it is proud of the end of the injector or syringe.

5      70. A needle as claimed in claim 69 in which the needle barrel projects a distance of more than 1mm from the bottom of the hub or injector or syringe barrel.

71. A needle as claimed in claim 69 in which the distance from the needle barrel to the adjacent sidewalls of the hub or syringe or injector barrel is more than 0.1mm.

10     72. The use of a needle as claimed in any one of the preceding claims to add or remove substance or device for medicinal or diagnostic or other purposes for human or animal or other applications.